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E1S SLN SLS2

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(56) Documents Cited

GB 2176831 A GB 1194489 A US 4583466 A

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ON-LINE DATABASE: WPI

## (54) Retractable stairs

(57) A retractable stairway 10 has a number of steps 34 to 38 which are pivotally inter-connected by a linkage mechanism formed by a number of parallel links 44 to 50. Each step has a recess formed in its under side into which the next step below can nest. The recess is formed by respective depending flanges 52, 54, 56 formed on each side of each step with each link being pivotally connected to the inner surface of one flange and the outer surface of the flange of the next below step. This allows the links to nest in the space formed between the flanges when the stairway is in its collapsed position, reducing the amount of space required.

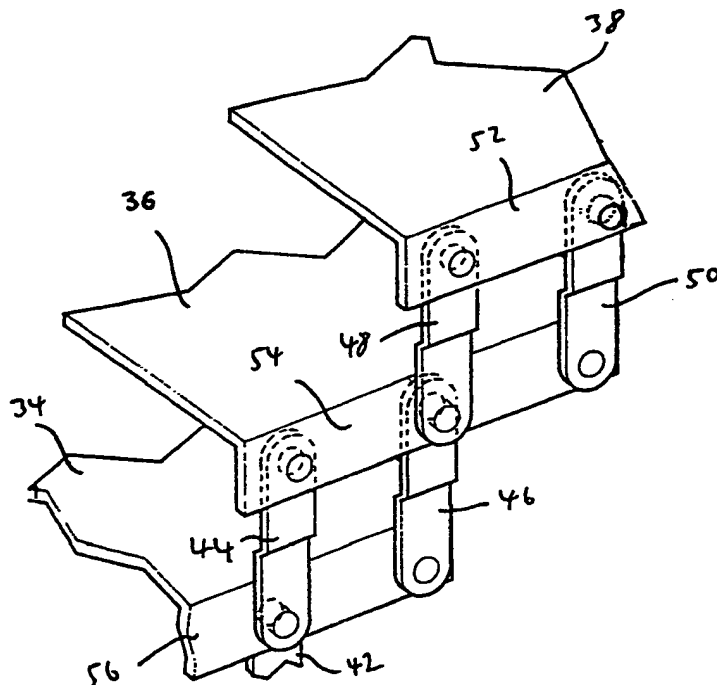


FIG 7

1/6

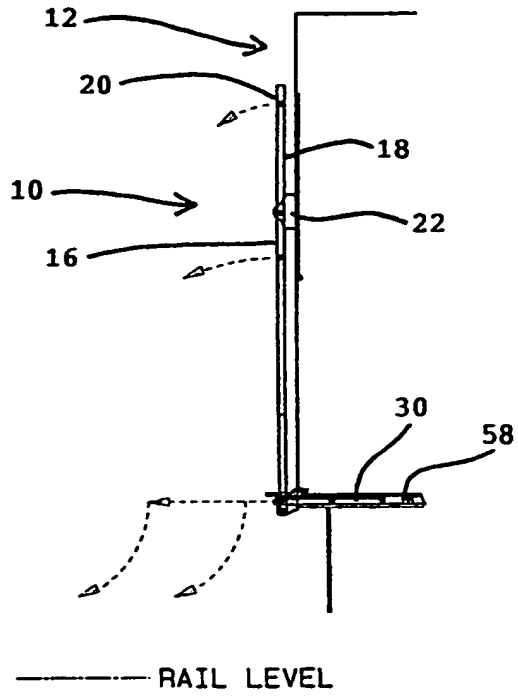
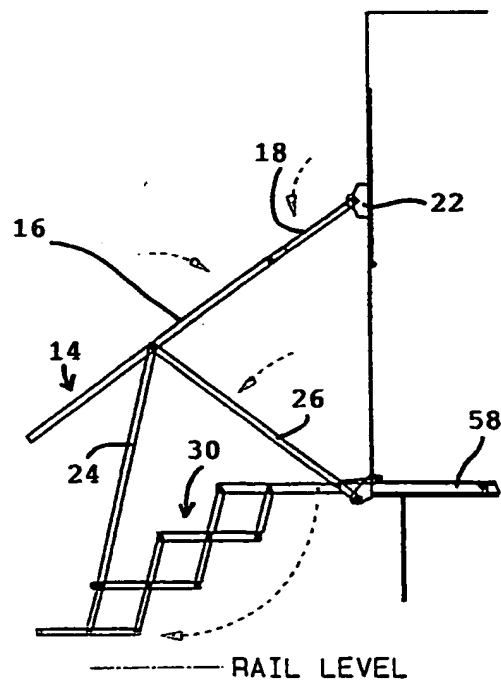


FIG 3





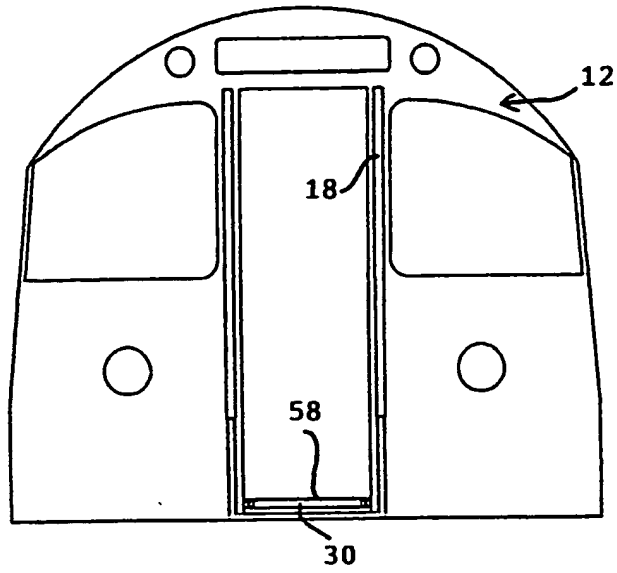


FIG 4

RAIL LEVEL

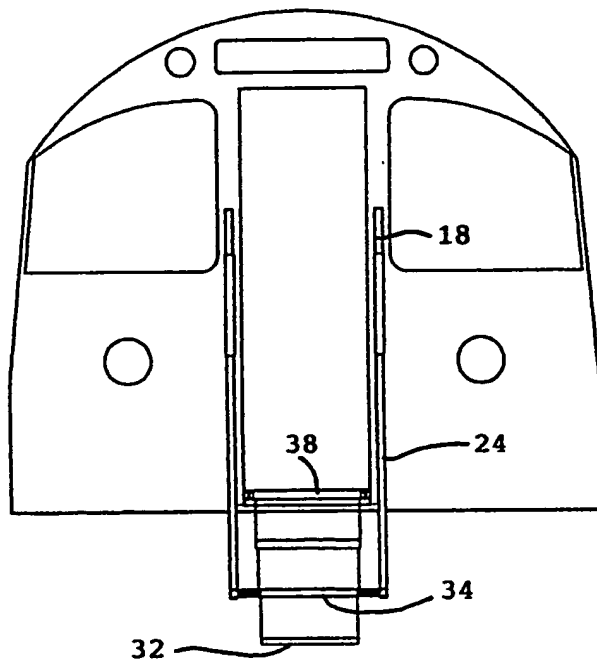


FIG 5

RAIL LEVEL

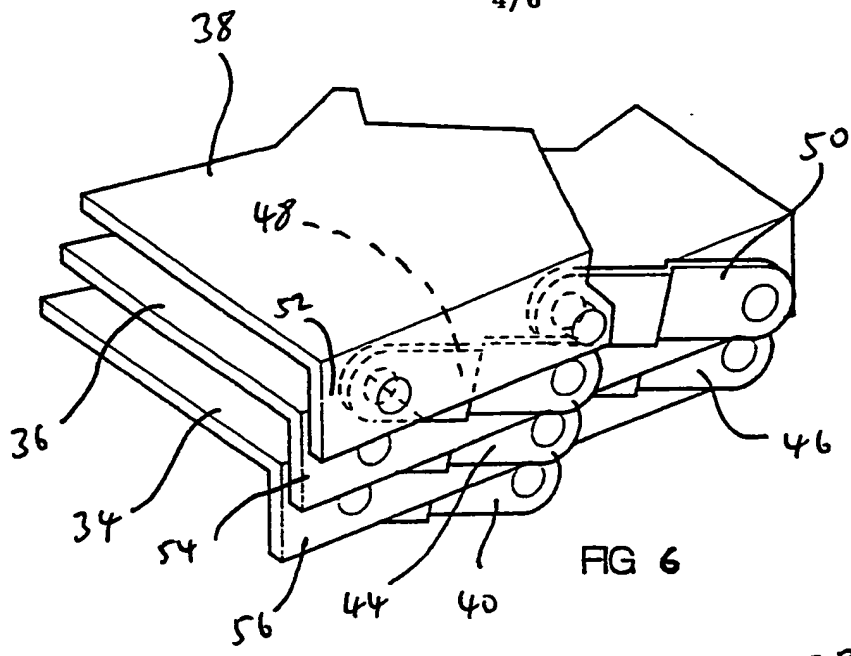


FIG 6

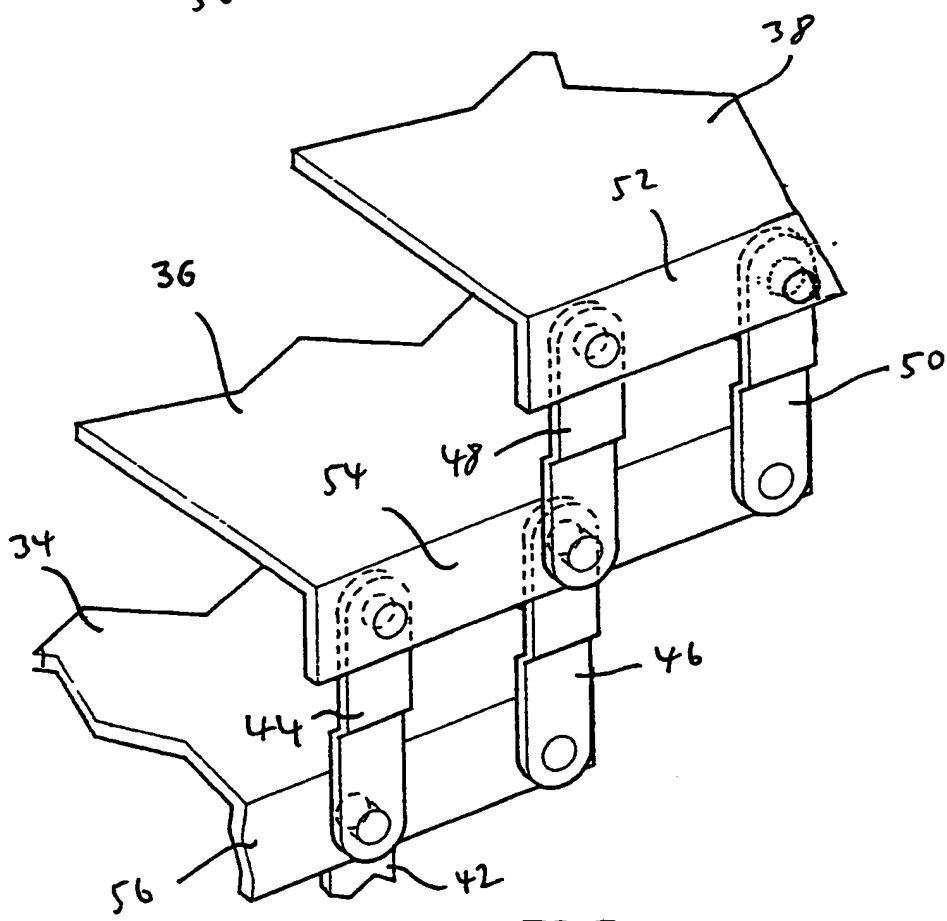
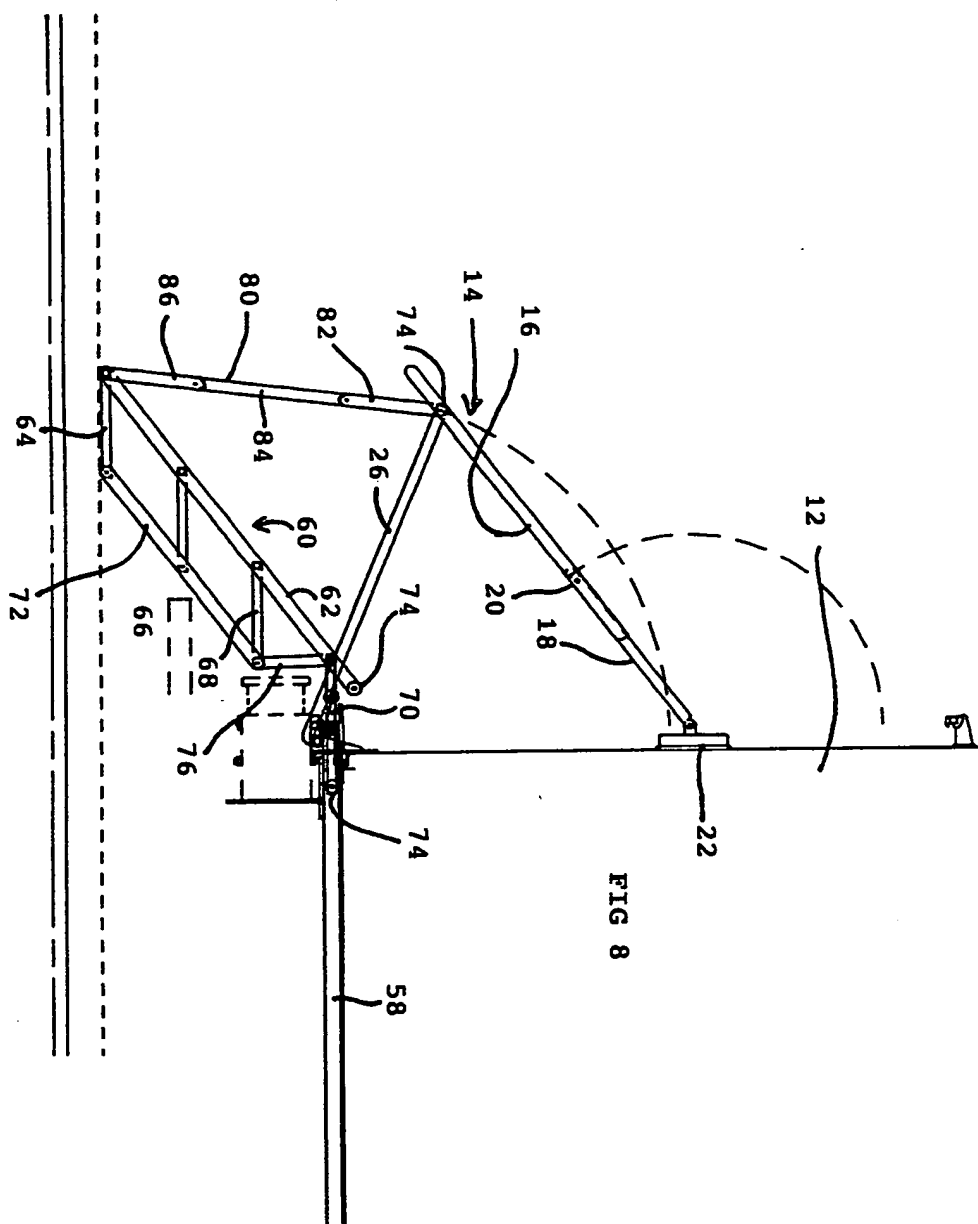


FIG 7



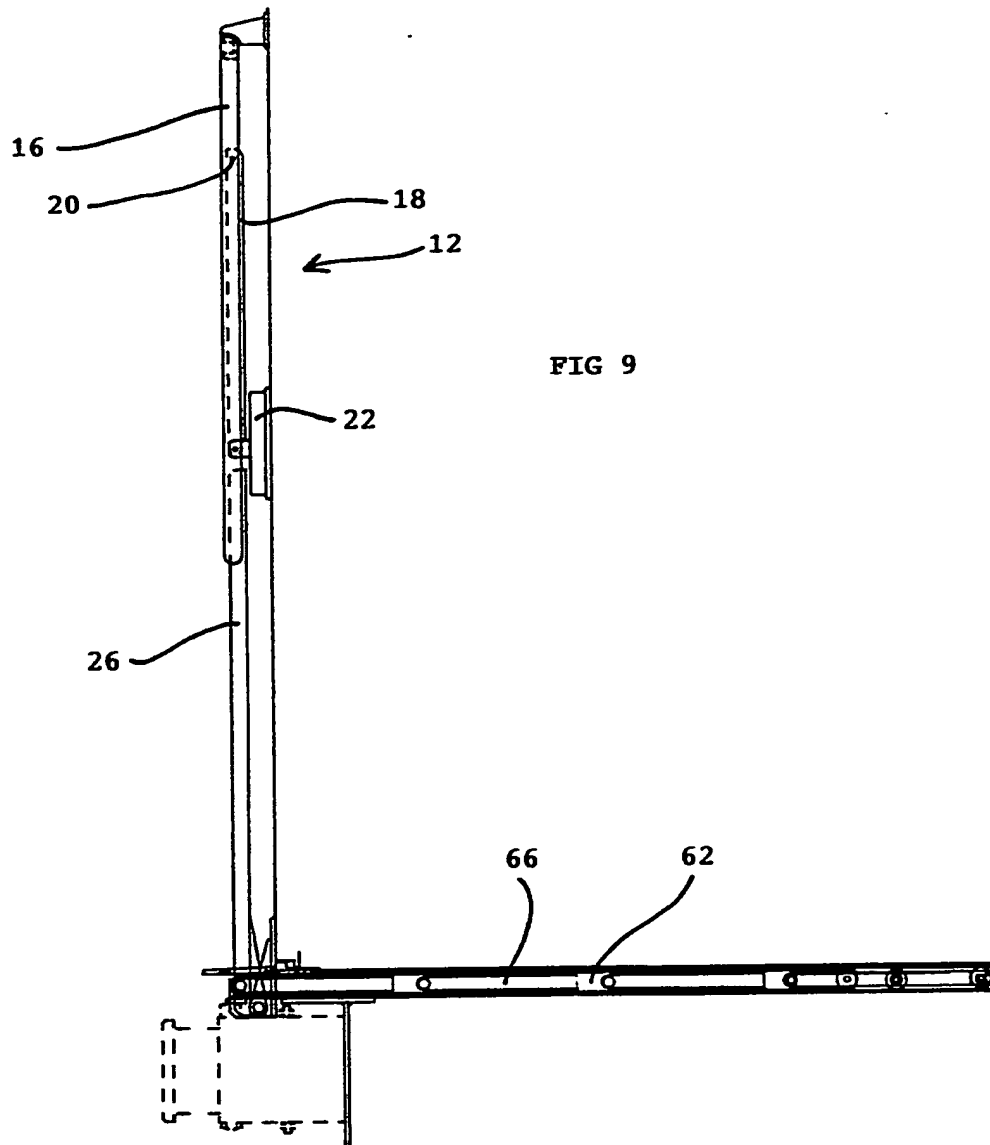


FIG 9

title: Retractable Stairs

The present invention relates to retractable stairs.

To descend from, for instance, a loft or from a vehicle where the floor is some distance above the surface on which the vehicle is standing, it is sometimes necessary to deploy a stairway or stairs. It is also desirable that the stairway have one or two hand rails at a suitable height to provide support to users of the stairway. However, it is often inconvenient for such a stairway to be a permanent fixture and there is often a need for the stairway to be designed in such a way that the stairway can be folded or collapsed into a relatively compact form.

Accordingly, the present invention provides a retractable stairway having a set of stairs comprising a plurality of steps pivotally inter-connected by a linkage mechanism such that said steps are movable between a first, retracted position and a second, extended position and wherein, in said retracted position, said steps occupy a vertical space less than the combined height of said steps.

The present invention is further described hereinafter, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side elevation of one end of an underground train carriage fitted with a stairway according to the present invention, shown in its collapsed or folded position;

Figure 2 is a view similar to that of Figure 1 showing the stairway partially extended;

Figure 3 is a view similar to that of Figure 1 showing the stairway in its fully extended position;



Figures 4 are end elevations of the train carriage corresponding to Figures 1 and 3 showing the stairway in its folded and extended positions;

Figure 6 is a perspective view of the stairs of the stairway of Figure 1 in a partially extended position;

Figure 7 is a view of the stairs of Figure 6 in an extended position;

Figure 8 is a side elevation of a further embodiment of a stairway according to the present invention, shown in its fully extended position; and

Figure 9 is a side elevation of the stairway of Figure 8 in its collapsed position.

Referring firstly to Figures 1 to 7, these show a stairway 10 which is mounted on one end 12 of an underground train carriage.

The stairway has two hand rails 14 each of which is formed by two pivotally interconnected rods 16, 18, the rods being pivotally connected at pivot point 20 at adjacent ends. The opposite end of rod 18 is also pivoted to a bracket 22 mounted on the train carriage whilst the rod 16 is pivoted intermediate its ends to two further rods 24, 26. The end of the rod 26 remote from the rod 16 is pivoted to a bracket 28 attached to the train carriage at the floor level whilst the end of the rod 24 remote from rod 16 is pivoted to an outer end of a step 34 of a set of stairs 30. As can be seen from the drawings, four steps are provided in the illustrated embodiment, although this number may be varied.

The rods 16 and 18 are pivoted together at pivot point 20 in such a manner that they can pivot together from a folded position or partially folded position as shown in Figures 1 and 2 into the position shown in Figure 3 where they are substantially axially aligned. A stop or catch or other suitable mechanism prevents

their pivoting beyond the position shown in Figure 3.

As can be seen from Figure 2, 6 and 7 the stairs comprise several steps 32, 34, 36 and 38 which are interconnected by several parallel links 40 to 50. The stairs have identical links arranged on each side and therefore only the arrangement on one side of the stairs is described.

The arrangement of the links is shown in detail in Figures 6 and 7 which show three of the steps of Figure 2 partially cut away for clarity.

As can be seen from Figures 6 and 7 each stair has a depending flange 52 to 56 at each side edge thereof with the dimensions of the steps such that each step can nest within the cavity formed by the depending flanges of the next above step when in the collapsed position. To effect this nesting each link 40 to 50 is pivotally connected to the inwardly facing surface of the flange of the associated upper step and the outwardly facing surface of the flange of the associated lower step. For example, the upper end of link 48 is pivoted to the inner surface of the flange 52 of step 38 whilst the lower end of link 48 is pivoted to the outer surface of the flange 54 of step 36. The link immediately below link 48 which is link 46 has its upper end pivoted on the same pivot axis as the lower end of link 48 but to the inner surface of the flange 54 of step 36 whilst its lower end is pivoted to the outer surface of flange 56 of step 34. This arrangement is effected with all of the links on both sides of the stairs so that when in their collapsed or folded position the links actually lie between adjacent flanges of the stairs. For example, link 46 lies generally horizontally between flanges 54 and 56 when the stairs are in their collapsed position.

This arrangement of the stairs and links enables the stairs to be folded into a much more compact attitude than with hitherto known collapsible or folding stairways. As a result, this enables the collapsed stairs to be slid into a recess 58 beneath

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or in the floor level of the train carriage, the recess having much smaller depth than would otherwise be necessary.

To unfold the stairway from its folded position as shown in Figure 1 the folded stairs are drawn from the recess 58 which causes the rod 18 to pivot about the bracket 22 away from the train carriage. The rods 18, 24, 26 and 16 continue to pivot about their respective pivot points as the stairs 30 are drawn further out and unfold about their links 40 to 50 through the position shown in Figure 2 into the unfolded position shown in Figure 3. In this position, the rods 16, 18, 24 and 26 retain the stairs in a substantially rigid, extended attitude.

A locking device is provided to prevent accidental unfolding of the stairway, for example whilst the train carriage is moving. When in their stowed position the stairs are covered by a plate which replaces the normal sill plate of the train carriage.

Referring now to Figures 8 and 9, these show a further embodiment 100 of a stairway according to the present invention fitted to one end 12 of an underground train carriage. Like parts with those of Figures 1 to 7 are given like reference numbers.

The stairway is similar to that shown in Figures 1 to 7, having hand rails 14 (only one of which is shown) formed by pivotally inter-connected rods 16, 18, with an additional pivotally inter-connected rod 26 and a link member 80 supporting a set of stairs 60. However, the stairs 60 are formed by two parallel rails 62 to which several steps 64 to 70 are pivotally mounted at their leading edges. The trailing edges of the stairs 64 to 68 are also pivotally inter-connected by a further pair of rails 72 arranged such that the steps 64 to 68 can be pivoted in unison between the generally horizontal attitude shown in Figure 8 and a position wherein the steps are co-planar with and between the rails 62.

The link member 80 and rod 26 are pivotally inter-connected at

pivot point 74 with the rod 16 and may be provided with a lock to lock the pivot point 74 relative to the rod 16 when the stairway is fully extended. Locks may also be provided at the bracket 22 and the open end of the recess 58 to lock the stairway in its fully collapsed position and prevent inadvertent actuation. Suitable spring biasing means (not shown in the drawings) are provided to bias the rails 62 outwardly of the recess 58.

The link member 24 may be a flexible member in the form, for example, of a wire or rope or may preferably be formed by three pivotally inter-connected links 82, 84, 86. This allows the link member 80 to collapse during folding and extension of the stairs.

Assuming that the stairway is in its fully collapsed position with the stairs 60 retracted into the recess 58, in order to extend the stairway the locks are released and the stairway 60 is drawn to the left as seen in Figure 9, out of the recess 58, assisted by the spring biasing means. Movement of the stairway 60 may be assisted by the provision of suitable wheels 74 on the rails 62 and the uppermost step 70.

As the stairs 60 are drawn out of the recess 58 the rods 16 and 18 pivot about the pivot point 20 and the bracket 62. The rod 26 and member 80 also pivot about their respective pivot points. When the stairway 60 is fully drawn from the recess 58 and lowered into the position shown in Figure 8 where it is retained by the inter-action of the rods 16, 18, 26, member 80 and rails 62, the steps 64 to 68 pivot into the horizontal position under the action of gravity. The pivoting of the steps 64 to 68 out of the plane of the rods 62 is limited by a preferably flexible member 76 inter-connecting the uppermost two steps 68 and 70.

To collapse the steps, the locks at the pivot points 74 and 20 (where fitted) are released and the stairway 60 is raised into a horizontal attitude whilst the links 82, 84, 86 pivot about their respective pivot points. When the rails 62 are generally

horizontal, the steps 64 to 68 can be pivoted into the plane of the rails 62 simply by manually pivoting one of the steps, and once in this position the stairs 60 can be slid into the recess 58. The pivot point 20 is then moved in the direction of arrow A (Figure 8) to pivot the rods 16, 18 into their upright position to move the stairway into its fully collapsed position where it can be locked in place.

**CLAIMS**

1. A retractable stairway having a set of stairs comprising a plurality of steps pivotally inter-connected by a linkage mechanism such that said steps are movable between a first, retracted position and a second, extended position and wherein, in said retracted position, said steps occupy a vertical space less than the combined height of said steps.

2. A retractable stairway having a plurality of steps each of which has a recess means in the underside thereof;

and wherein:

each said step is dimensioned to nest in the recess means of the next above step,

and said step are pivotally inter-connected by a linkage mechanism, the arrangement being such that said steps are movable between a first, retracted position wherein each step nests in the recess means of the next above step and a second, extended position.

3. A retractable stairway as claimed in claim 2 wherein, in said first position each said step lies immediately below the next above step.

4. A retractable stairway as claimed in claim 2 or 3 wherein each step has a floor member and a respective depending flange at each side thereof, said flanges and said floor member defining said recess means.

5. A retractable stairway as claimed in claim 4 wherein said linkage mechanism comprises a plurality of substantially parallel links and each said link pivotally connects an inwardly facing surface of a flange of an upper step with an outwardly facing surface of a flange of the next adjacent lower step.

6. A retractable stairway as claimed in any of claims 2 to 5 wherein said stairway is secured to a support and the arrangement is such that movement of the uppermost step away from said support causes said stairway to move from its first, retracted position towards its second, extended position.

7. A retractable stairway having a set of stairs wherein said stairs comprise:

a plurality of steps pivotally inter-connected by a linkage mechanism such that said steps are movable between a first, retracted position wherein said steps are substantially co-planar and a second, extended position.

8. A retractable stairway as claimed in claim 7 wherein said linkage mechanism comprises side members pivotally inter-connecting said steps.

9. A retractable stairway as claimed in claim 7 or 8 wherein said linkage mechanism comprises side members pivotally inter-connecting said steps at or adjacent their leading edges.

10. A retractable stairway as claimed in claim 7, 8 or 9 wherein said linkage mechanism is such that said steps are pivotable in unison between said first and second positions.

11. A retractable stairway as claimed in any of claims 7 to 10 wherein said stairway is secured to a support and the arrangement is such that movement of said steps away from said support causes said stairway to move from its first, retracted position towards its second, extended position.

12. A retractable stairway as claimed in claim 11 further comprising a handrail pivotally connected to said support and said linkage mechanism such that movement of said steps away from said support pivots said handrail from a retracted position towards an extended, in use, position.

13. A retractable stairway as claimed in claim 12 wherein said handrail is connected to said linkage mechanism by a flexible link at or adjacent a lower edge of said stairs.

14. A retractable stairway substantially as hereinbefore described with reference to Figures 1 to 7 or Figures 8 and 9 or the accompanying drawings.



**Relevant Technical Fields**

- (i) UK Cl (Ed.L) E1S (SLSZ, SLJ): B7L (LK)  
(ii) Int Cl (Ed.5) E06C 1/54; B61D 23/02; E04 11/06; E06C 5/28

Search Examiner  
A H MITCHELL

Date of completion of Search

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-  
1-14

(ii) ONLINE DATABASE : WPI

**Categories of documents**

- X: Document indicating lack of novelty or of inventive step. P: Document published on or after the declared priority date but before the filing date of the present application.  
Y: Document indicating lack of inventive step if combined with one or more other documents of the same category. E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.  
A: Document indicating technological background and/or state of the art. &: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2176831 A (KELLY) - see the nested steps, Figure 4	1-4
X	GB 1194489 (UNITED AIRCRAFT) - Note coplanar steps 12, 16, Figure 3	7-11
X	US 4583466 (REDDY) - see coplanar steps, Figure 1	7

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).